An ultrahigh speed assembly robot system. Part I. Design
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A new architecture of assembly system using ultrahigh speed direct drive robots is presented. In the new architecture, multiple robots perform assembly tasks in a highly coordinated manner. Unlike traditional assembly machines in which printed circuit boards are moved and positioned by x-y tables, the new system uses a precision conveyor to carry pc boards at a constant speed, and chips are placed by robots while the pc boards are continuously moving. This allows us to eliminate the time required for loading and unloading of pc boards and, more importantly, does not dislocate the chips mounted on pc boards since no large acceleration is generated on the pc boards. Also in the new architecture, a bunch of part feeders are divided into several groups and secured stationary along the conveyor line. Multiple robots distributed along the conveyor line share the tasks in a parallel, distributed manner. First, the design concept of the assembly robot system is addressed, followed by the design of ultrahigh speed robots. To increase the throughput of the system, a new methodology for simultaneous optimization of both mechanical design and control design is developed and applied to the ultrahigh speed robot design. Twin direct drive robots capable of placing more than 10 chips per second are designed, built and tested. Through experiments, positioning accuracy and throughput of the developed system are evaluated.

DESCRIPTOR(S)- assembling; circuit CAD; industrial robots
IDENTIFIER(S)- assembly tasks; control design; conveyor line; design concept; mechanical design; multiple robot distribution; multiple robots; part feeders; pc boards; precision conveyor; simultaneous optimization; ultrahigh speed assembly robot system; ultrahigh speed direct drive robots
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